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Such assistants as there are are personal helpers of the professors, below whom there is a great gulf fixed, and administration is divisible among two score heads instead of being centered in one office. Each professor is the head of his own department of *Anstalt*, and quite independent in most of his affairs. He is his own president, and the university is no more than the sum of all its parts.

The American universities are not yet universities. They are destined to become such, but not until as a first step the first two years, the students and the teachers of the junior college are relegated to the high school, or the college. To abolish the president, or to cut off his salary, to change his powers materially, or to find some other type of man, would not affect the case materially, so long as teaching of boys is regarded as university business. This is college business. The college is a co-operating organism far more than the sum of all its parts. It has moral duties, more vital than its duties to research. So long as the institution tries to carry this double function of college and university in the same buildings with the same staff, the present difficulties must persist. In this same period we must bear the double criticism that our professors do not do their part in the advancement of science, and on the other hand that they talk too much of research and give too little attention to mental drill, and to the moral and social development of boys under their charge.

Besides all this, all our universities or colleges are still in process of creation. Not one of them is an existing institution. The president must furnish the initiative, set the pace, mark the color of a growing institution. He must consider relative values, what expenditure of money will count for most in the long run, and the ways and means by which the necessary money can be obtained. The Duke of Wellington once observed that an army may be commanded by a very ordinary man, but "not by a debating society." "An institution is the elongated shadow of a man." Taking any of our great state universities as an illustration, can we believe that any one

of these has reached its final status? Do we not feel sure that every one of these will have in another ten years double the resources, double the equipment, double the prestige it has now? Do we believe that in any case this change would be possible unless the university had the service of individuality in its executive relations? The people pay for the university, and the people in America pay not because the maintenance of universities is a function of government, but from the feeling that the university is doing their work and that there is no better use to be made of their money. The universities on private foundation depend equally on public appreciation, and in equal degree they are forced to appeal to their own public. So long as no single institution of higher learning in America has its permanent form, so long as its administration is a struggle, not a function, so long as we all agree that each school must and should die if it can not progress rapidly and toward some ideal, every college or university will recognize some leader, and this leader will have most of the functions of a college president. This fact will not justify all the things any college president may do, not even most of the things some individuals among them do. Still on the whole their operations have been marked by wise patience and well considered action. We can not do without them yet. No one will look forward more eagerly than they to the time when they and their kind will be found unnecessary in the higher education of America.—President David Starr Jordan in *The Independent*.

SCIENTIFIC BOOKS

Principles of Microscopy, being a Handbook to the Microscope. By Sir A. E. WRIGHT, M.D. (Dublin), F.R.S., Director in Medical Charge of the Department for Therapeutic Inoculation, and Pathologist, St. Mary's Hospital, London, W. Pp. xxii + 250; 18 plates and 97 figures in the text, also a diffraction plate for use in the experiments. New York, The Macmillan Company. 1907.

The distinguished author of this treatise is

better known to medical men than to microscopists, using the latter term in its more restricted sense.

As his work, especially upon the "opsonins," has been so largely dependent upon the aid of the microscope he came naturally to appreciate that instrument and to realize the need of a thorough understanding of its possibilities and limitations for the investigator who must enlist its help in his researches.

The keynote of the work is struck in the opening paragraphs of the preface:

Every one who has to use the microscope must decide for himself as to whether he will do so in accordance with a system of rule of thumb, or whether he will seek to supersede this by a system of reasoned action based upon a study of his instrument and a consideration of the scientific principles of microscopical technique.

The present text-book has no message to those who are content to follow a system of rule of thumb, and to eke this out by blind trial and error.

It addresses itself to those who are dissatisfied with the results thus obtained, and who desire to master the scientific principles of microscopy, even at the price of some intellectual effort.

The book in carrying out the plan just indicated deals with the microscope itself. It is not a work upon animal or vegetable histology with just enough about the microscope to enable the student to know which end of the instrument to look into, and with this to expect the student to elucidate all the complex structure of animal or plant.

Part I., included in the first 48 pages, deals with what the author calls the "stage picture," that is, the object and its illumination. It is shown by abundant and easily performed experiments just what it is necessary to do to prepare and illuminate objects so that they may be visible with the microscope by the so-called dark outline (refraction image) or by coloration (color image). In forecasting the future with respect to the discovery of the causes of diseases such as scarlatina, measles and many other human and animal diseases, he controverts the assumption made by many that the organisms, if they exist at all, are of "ultra-microscopic minuteness" and adds:

This failure appeals only as an illustration of the rule that micro-organisms (with rare exceptions) remain for all practical purposes invisible and unidentifiable in the interior of the organism until methods of differential staining are discovered which allow of their representation in the stage picture. If we have here, as the present writer believes, the true explanation of the ill success of the bacteriological microscopist in the matter of the discovery of the germs of the diseases specified above, that discovery can not be expected until further progress shall have been made in those comparatively unregarded, but in reality fundamentally important, chemical researches which lead up to the invention of new processes of differential staining.

In Part II., including about 190 pages, the author takes up the formation of images by the microscope and the function of each one of the optical parts or elements involved.

In the first place it is shown that a simple aperture may form an image and that the inversion of the image and the magnification are the same as when a lens is used; but while this is true he proceeds to illustrate, again by abundant experiments, the difference in clearness of the lens-formed image and that of the simple aperture (pin-hole picture). In this study there is shown with admirable simplicity how to determine the aperture and the significance of the same in image formation.

The aberrations (spherical and chromatic) of lenses are illustrated and the methods of elimination discussed, as well as the effects produced by diffraction. It seems to the reviewer that the question of diffraction in microscopic vision receives in this work the most lucid treatment on record; and going with this is the most satisfactory discussion of the relation of microscopic and naked-eye vision. It must be confessed that for the average worker with the microscope it is disquieting to have it impressed upon him that microscopic vision is totally unlike naked-eye vision, as is done in many works and papers upon the subject. Just where the break comes in between naked-eye vision and that with spectacles, the simple or the compound microscope, no one has determined. That diffrac-

tion plays an important rôle in high-power work with the microscope no one will deny. This author gives it its true value in microscopic vision, connecting all vision together instead of making a violent change somewhere.

In this work the statement is frequently reiterated that the eye of the observer forms a part of the optical apparatus, being in this respect in refreshing contrast to those that ignore the eye in dealing with the microscope. The author takes up every other difficult question relating to the microscope, as angular and numerical aperture, dark-ground illumination, the production of critical images, the limitation of microscopic vision propounded by Helmholtz and others, and each subject is simplified.

With reference to the Helmholtz theory of the limitation of resolution in microscopic vision, the statement or formula of Helmholtz is cast in a form familiar at present in microscopical optics and is shown to be $0.6 \lambda / \text{N.A.}$, that is, the wave-length of the light used multiplied by 0.6, and this divided by the numerical aperture (N.A.) of the objective will give the limits of visibility. Numerous examples are given showing that this theoretical limit is very close to the actual limit with the best modern microscopes as ordinarily used. The point is not yielded, however, without showing a possible escape from the apparent restrictions. In dealing with high magnifications he says:

The three impediments to resolution just referred to are: (a) diffusion, (b) conspicuous antipoint and (c) obfuscation in the eye.

He shows that all these defects are directly referable to the contraction of the beam incident to high magnifications, and that the only way to escape these limitations is to increase the aperture or, as he puts it, "to open up the terminal beam." He then considers the method of Gordon by which the terminal beam is widely opened by means of a disc of ground glass placed at the level of the diaphragm in the Huygenian ocular, that is, at the level where the real image is formed. This real image is then observed by a second, low-power microscope. To avoid the obscurity

given by the grain on the ground glass the latter is rotated.

It is stated that by this means Mr. Gordon has shown repeatedly before the Royal Microscopical Society objects under "magnifying powers of 10,000 diameters and over," the retinal image being free from obfuscation and conspicuous antipoint. To enforce the argument and to show the reader the appearance with and without the opening up of the terminal beam, Plate XVIII., with five photographs, is given, illustrating in the most striking manner the points mentioned in the text.

This book is beautifully printed and its numerous figures really illustrate the text. In a word it is the clearest and most authoritative exposition of the microscope and its accessories and the interpretation of microscopic appearances to be found in any single work. It is sincerely hoped that it will speedily find its way into the hands of teachers and advanced students.

S. H. G.

Selectionsprinzip und Probleme der Artbildung. Ein Handbuch des Darwinismus. Von Dr. LUDWIG PLATE. Dritte, sehr vermehrte Auflage, mit 60 Figuren im Text. Leipzig, Engelmann. 1908. Pp. viii + 498.

That Plate's work on the principle of selection and the problem of the origin of species should in eight years have passed through three editions is welcome evidence that the reading public appreciates a good biological treatise; that it should in the respective editions pass from 153 pages and 247 pages to over 500 pages with illustrations is evidence both of the great recent growth of contributions to the subject and of Plate's enterprise in following them up.

The principal additions to this last edition consist of a brief review of Darwinism, a discussion of Darwin's and de Vries's views of the rôle of individual variation; an extension of the section on "Sprungevolution"; a consideration of a new objection to Darwin's principle of selection, viz., that selection can not be demonstrated in detail; additional consideration of the forms of the struggle for